

WAD TSA-16

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5-16-95

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TASK TITLE: GROUND COMMAND AND CONTROL SYSTEM (GCCS) FOR THE  
AERIAL CABLE RANGE.

WORK TITLE: INDEPENDENT GCCS ANALYSIS, RECOMMENDATION, AND  
DOCUMENTATION.

## WORK ASSIGNMENT ORDER (WAO)

### 1. SCOPE.

The Contractor shall provide the hardware and software analysis, recommendation, and documentation for the GCCS of the Aerial Cable Range (ACR).

### 2. APPLICABLE DOCUMENTS.

- a. GCCS hardware theory of operation.
- b. GCCS operator's manual.
- c. GCCS header file listings.
- d. GCCS code listings for the sun XGL system.
- e. GCCS code listings for the Force 68040 and Link Message Buffer (LMB).
- f. GCCS code listings for the Sun Xview System.

### 3. REQUIREMENTS.

The Contractor shall perform an independent analysis on the current GCCS hardware and software designs, provide the recommendations to modify the hardware and software of the existing GCCS, and document all the existing GCCS software.

3.1 The Contractor shall analyze the two existing UHF links, used to uplink/downlink the commands and controls between Little Burro mountain (low anchor point ) and the target on the cable. Currently Unrecognizable messages are present and passed to the control system and the error frequency increases as the target moves away from Little Burro mountain. The frequencies used for the command and control system are:

#### 3.1.1 Link #A

- a. Transceiver #1 TX-420.5 MHZ RX-425.5 MHZ.
- b. Transceiver #2 TX-425.5 MHZ RX-420.5 MHZ.

#### 3.1.2 Link #B

- a. Transceiver #3 TX-422.5 MHZ RX-427.5 MHZ.

b. Transceiver #4 TX-427.5 MHZ RX-422.5 MHZ.

The transmitted power is one watt and the bandwidth is +/- 5 KHZ carrier modulation deviation with total emission bandwidth of less than 16 KHZ. The transceivers have full duplex capability, and the characteristics of Motorola K24LCF1103P link unit. The antennas have one +dbi gain vertically polarized which is frequency scaled version of an omni-vertical dipole antenna.

3.2 The Contractor shall conduct an independent analyses on the existing hardware, and software documentation of the GCCS and provide to the Government a list of the needed information to properly document the system for future modifications and diagnosis.

3.3 The Contractor shall evaluate the existing GCCS and recommend changes and modifications for the system to become easier to modify, reduce the error rate, and increase the reliability.

3.4 The Contractor shall document all the existing GCCS software code and develop flow charts to help the maintenance personnel to understand and diagnose the system.

#### 4.0 QUALITY ASSURANCE PROVISIONS.

4.1 General. The Contractor shall comply with the inspection article of the contract.

#### 5.0 DELIVERY.

5.1 Written reports on the results and status of the studies shall be provided monthly.

5.2 A review meeting shall be conducted between the Government Representatives and the Contractor representatives NLT once every two weeks to report and discuss technical progress, coordinate site visits to obtain or verify needed information, discuss any obstacles that might delay the project or cause the contract to exceed the existing budget.

5.3 The Contractor shall, analyze, develop, design, install, and make functional the necessary hardware and software to reduce the loss of the communication link, reduce the error rate, and increase the reliability by NLT 10 Sep 95.

5.4 The Contractor shall analyze the hardware and software of the GCCS and deliver an independent assessment of the necessary documents, information, and software needed to document the GCCS for future modifications by NLT 10 Sep 95.

5.5 A final report shall be generated by the Contractor

recommending changes to be made on the hardware and software of the GCCS by NLT 30 Sep 96.

5.6 A final report shall be generated by the Contractor documenting all the existing GCCS software and evaluating any potential glitches in the code. This documentation shall include flow charts to help understand the software for future diagnosis and modifications by NLT 30 Sep 96.

5.7 The Contractor shall deliver to the Government all final designs, recommendations, documentation, and software code (source and executable) on four hard copies and two disk media by NLT 30 Sep 96.

#### 6.0 NOTES.

The Government will provide all related documents to the Contractor and provide or arrange for the Contractor to copy all the necessary software to complete the assessment.

**GROUND COMMAND AND CONTROL SYSTEM (GCCS) ANALYSIS****ESTIMATES for WAO TSA-16**

Period of Performance **15 JUN 95 to 30 SEP 96**  
DAAD07-93-C-0125

**RESPONSE (by the Electronic Vision/Sensor Fusion Research Group, Department of Electrical and Computer Engineering, New Mexico State University)**

In response to the statement of work for the above WAO, we have reviewed the scope and goal of the project, section 1 of the WAO, and the specific requirements of the project, section 3 of the WAO. Based on these reviews and our past experience in this area, we are pleased to providing the following response:

**RELEVANT EXPERIENCE**

Two members of our research group are somewhat familiar with the overall GCCS design. In addition, we are currently working on another project associated with the Aerial Cable Range (ACR) which relates to the requirements of this WAO. Specifically, the current ACR project, entitled "Integration of Speech Control into the GCCS", requires interfacing to (and therefore an understanding of) the communications and control systems.

One of our team members is an antenna design specialist, another a software engineer, and a third has experience integrating computer systems. Each of these qualifications addresses a specific WAO requirement.

**PLAN OF WORK**

The plan of approach to this project is divided into two parts: 1) addressing the UHF data link problem, and 2) analyzing the GCCS hardware and software.

**UHF Data Link:** Section 3.1 of the WAO describes a problem of unrecognizable messages being sent. A preliminary analysis of this problem suggests two (2) solutions:

- 1) **Antennas:** Due to the terrain around the Little Burro terminal and the varying geometry as the target moves along the cable, we feel the problem is a result of multi-path. As a solution, we propose replacing the existing antennas with high gain, circularly polarized, directional types. This will provide both a high degree of multi-path rejection and an increase in signal strength. This solution offers the best chance of success and could be done quickly.
- 2) **Software:** As a last resort (ie- new antennas do not solve the problem) the message packets will have error detection & correction fields added. At the very

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least, this will prevent a garbled message from interfering with the continued operation of the GCCS equipment. A sufficiently rich error correction scheme will allow for the reconstruction of the original message. This solution is by far the most difficult to implement, insomuch as it entails rewriting portions of the software, both on the cable and on the ground.

**Hardware\Software:** Sections 3.2, 3.3, and 3.4 of the WAO will all be addressed in parallel. Once the applicable documents (as listed in section 2 of the WAO) are received, we will begin to comment and flowchart the existing software. This directly speaks to section 3.4. Since much of the software is involved in the low-level control of hardware, a thorough understanding of the hardware must also be achieved. In the process of this analysis, any incomplete or missing documentation will be discovered and reported to the government, as required in section 3.2. An inescapable byproduct of such an in-depth review of the hardware and software by trained engineers is the formulation of recommendations to improve the system, as required in section 3.3.

**Period of performance:** The work we propose will be performed between June 15, 1995 and September 30, 1996. This period is sufficient to acquire and test the recommended equipment, document existing hardware/software, and make recommendations as to improvements.

#### DELIVERABLES

- 1) Short written reports will be provided monthly summarizing the activities, results, and status of the project.
- 2) Review meetings will be held every two (2) weeks with the Government Representatives to report progress and problems.
- 3) Four (4) new antennas will be mounted and tested within ten (10) weeks of spending authority. If necessary, error detection/correction codes will be included in the data messages NLT 10 Sept 95.
- 4) Provided the documents listed in section 2 of the WAO are made available NLT 1 Jul 95, a list of addition documents, required to completely analyze the GCCS, will be presented to the government NLT 10 Sept 95.
- 5) Final reports, flowcharts, and recommendations will be delivered at the end of the period of performance, including four (4) printed and two (2) machine readable copies of each document.

## SCHEDULE

Jun 15 - Jun 30 1995

- a. Prepare specifications for antennas.
- b. Open competition for purchase.
- c. Accept delivery of documentation listed in section 2 of the WAO.
- d. Deliver short written report summarizing June's activities.

Jul 1 - Jul 31 1995

- a. Receive, install, and test antennas.
- b. Begin analysis of existing software.
- c. Deliver short written report summarizing July's activities.

Aug 1 - Aug 31 1995

- a. Complete list of required documentation.
- b. Deliver preliminary recommendations for hardware/software improvements.
- c. Deliver short written report summarizing August's activities.

Sep 1 - Dec 31 1995

- a. Continue software/hardware analysis and flowcharting.
- b. Accept delivery of additional required documentation.
- c. Deliver short written reports summarizing each month's activities.

Jan 1 - May 31 1996

- a. Continue software/hardware analysis and flowcharting.
- b. Deliver short written reports summarizing each month's activities.

Jun 1 - Sep 31 1996

- a. Complete software/hardware analysis and flowcharting.
- b. Complete recommendations for future efforts.
- c. Deliver final report.